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GB A 2102594 GB 1396800 GB 0998672
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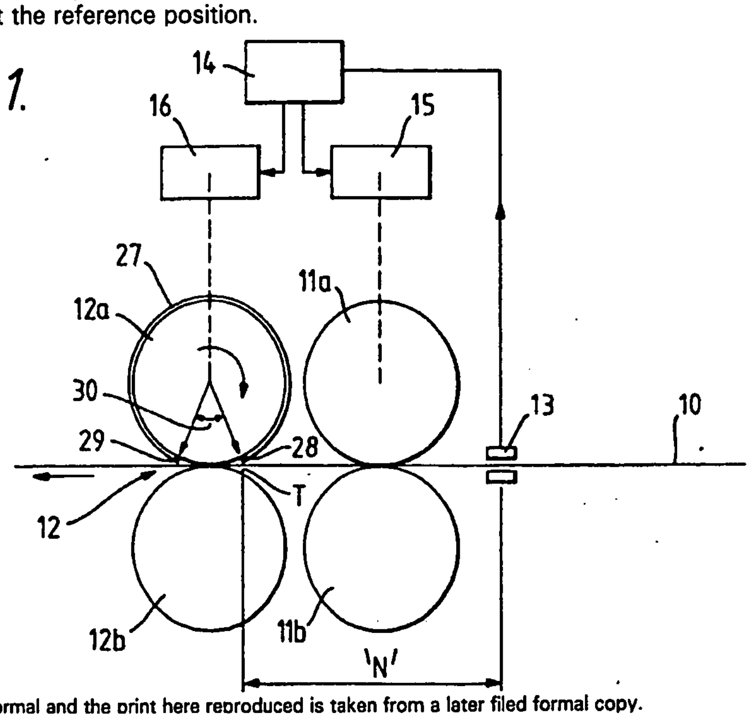
(54) **Rotary cutting machines**

(57) A rotary die cutting machine has a registration system for automatically synchronising a rotary die cutter 12 with a sequence of printed images (18 Fig. 2) being cut out from a record strip 10 the images being disposed one behind the other along the strip and each image or predetermined sequence of images having an associated register mark (19, Fig. 2). The system comprises periodically advancing a predetermined length of the strip 10 relative to the cutter 12, sensing a register mark (19) on the strip 10 during each period of advancement, comparing the actual position of the sensed mark at the end of the said period with the predetermined reference position and adjusting the relative positions of the cutter die 27 and the strip 10 before advancing the next succeeding length of the strip if the comparison indicates that the sensed mark is not at the reference position.

Fig. 1.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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Fig. 1.

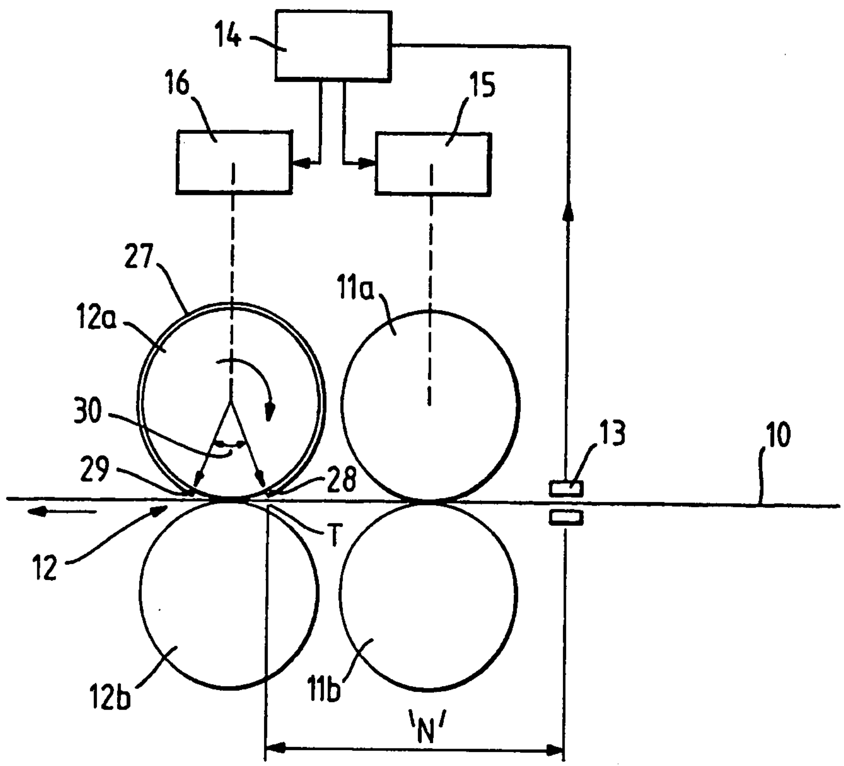
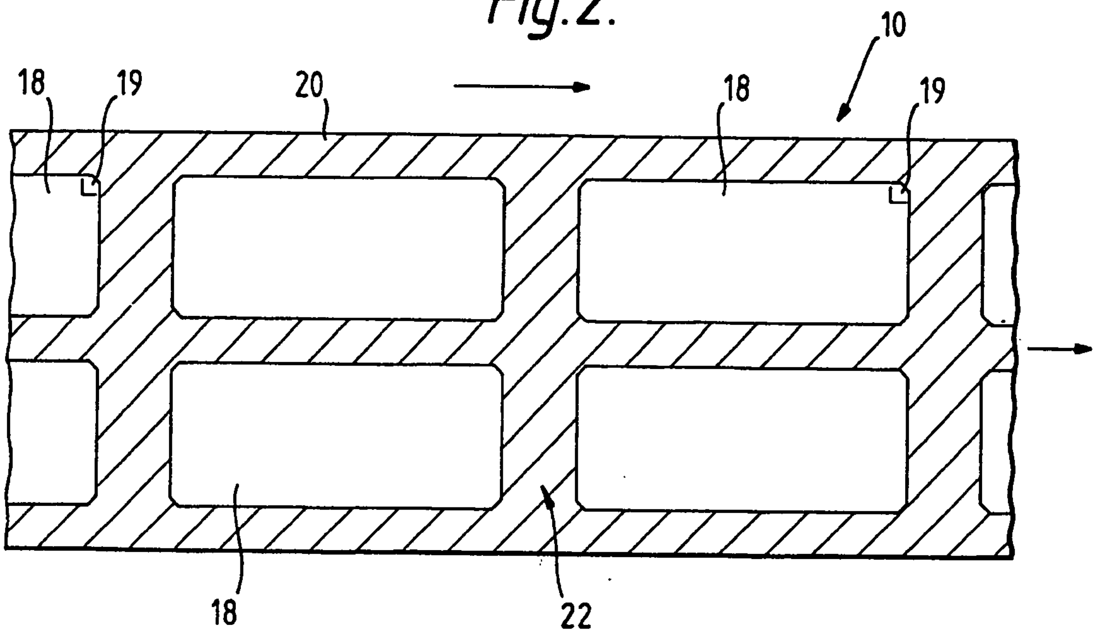


Fig. 2.



SPECIFICATION

Rotary cutting machines

When cutting discrete self-adhesive labels from a continuous web carrying an array or sequence of the labels in the form of printed images, it is known to use either a reciprocating die cutter or a rotary die cutter to cut around the periphery of each image or label as the web advances through a cutting station. Rotary cutters are known to achieve higher production speeds but require that the printing and cutting are synchronised with one another to ensure registration between the images and the cutting die at the cutting station. Such synchronisation can be achieved, for example, if the printing operation provides a registration mark for each printed image or for a predetermined sequence of images, and the speed of the rotary cutting is responsive to the output of a tracking head which tracks the registration marks.

It has been suggested that such commercially available label making machines might be modified to accommodate webs where the images are photographic images printed on a pre-sensitised medium, usually paper. However, a particular problem which arises when using photographic images to produce self-adhesive labels, is that the length of each image can vary due to overshoot, while a conventional tracking arrangement depends upon the distance between the registration marks being fixed. According to one prior proposal, the required registration is achieved by a combination of differential gears, light beam interference sensing and microprocessor control. This however has not been workable in practice because of the difficulty of producing the necessary fine gearing.

This problem is overcome according to the present invention by advancing a predetermined length of the web through the cutting station, sensing a register mark on the web during the period of advancement, comparing the actual position of the sensed mark at the end of the said advancement with a required reference position, and adjusting the relative positions of the cutter and the web before advancing the next succeeding length of the web if the comparison indicates that the sensed mark is not at the reference position.

The comparison is preferably achieved by storing a reference value equal to the distance between the sensing head and the required reference position, and then comparing this stored value with a measured value corresponding to the distance travelled by a register mark after it passes the sensing head.

The relative positions the cutter and the web are adjusted with the cutter disengaged from the web, For example, the cutter profile may extend only partially around the circumference of the cutter head such that the cutter is disengaged from the web for a predetermined sector of a complete revolution. This sector is preferably less than 45°, and more particularly may lie in the range of 10° to 20°.

The advancing means and the rotary cutter are preferably driven periodically through 360° by respective stepping motors. The distance travelled by the register mark after passing the sensing head in each cycle of operation is then measured by counting the pulses sent to the respective stepping motor after a register mark has been detected, the stored value corresponding to the number of pulses which would be required to bring the register mark to the reference position. At the end of the cycle, any discrepancy between the stored value and the measured value is corrected by driving the stepping motor of the advancing means in a forward or reverse direction to windon or wind back the web through the appropriate distance until the error is reduced to zero number of pulses.

The web may be a composite web consisting of a photographic printing medium superposed on a strippable backing sheet, the cutter profile being designed to cut through the photographic medium but not through the backing sheet. Accordingly, after the cutting operation, the waste photographic medium can be separately peeled away from the backing sheet to leave an array of peelable photographic labels.

By way of example only, one embodiment of the invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of a control system for a rotary cutting machine; and

Fig. 2 is a diagrammatic representation showing a sequence of photographic prints produced by the machine of Fig. 1.

Referring to these drawings, the rotary cutting machine includes a pair of nip rolls 11a, 11b for advancing a web 10 through a cutting station 12. The cutting station includes a cutter roll 12a and a backing roll 12b, the cutter roll having raised cutting edges 27 extending part way around the periphery of the roll, the profile of the cutting edges corresponding to the shape it is desired to cut from the web 10.

In this particular example, the web 10 comprises a composite web in which photographic printing paper is releasably bonded to a strippable backing sheet. The photographic paper has been exposed and processed to produce successive rows of printed images disposed one behind the other along the length of the web. The pattern of the cutting edges 27 on roller 12*a* corresponds to the pattern of the photographic images across the web, and the roller is set to cut through the photographic paper but not through the backing sheet. Accordingly, as shown in Fig. 2, after passing through the cutting station, the photographic

paper is separated into discrete self-adhesive labels 18 on the backing sheet 20, the waste photographic sheet material 22 (shown cros-shatched in Fig. 2) being peeled away from the backing sheet and wound on a separate roll (not shown).

The rolls 11 and the rolls 12 are driven by respective stepping motors 15 and 16 under the control of a microprocessor 14 responsive to the output from an optical sensor 13 which tracks register marks 19 printed with alternate images along the photographic sheet.

The operation of the system is as follows:

The web 10 is first brought to the position shown in Fig. 1 where a register mark 19 at the position T is located beneath the leading edge 28 of the cutter profile 27 on roll 12*a*. The distance between T and the tracking head or sensor 13 is equal to a number "N" of the incremental steps by which the web 10 is advanced by rolls 11 when driven by stepping motor 15.

Both the cutter rolls 12 and nip rolls 11 are now driven in synchronism through a complete revolution. At some point within this revolution, the next succeeding register mark 19 will pass the tracking head 13. The resulting signal from the tracking head is fed to the microprocessor 14 and starts a counter which, from that point onwards, counts the pulses fed to the stepping motors until both rolls stop at the end of the revolution. Each counted pulse corresponds to one incremental step of the stepping motor.

A comparator within the microprocessor then compares the number of counted pulses with a stored reference value, the reference value corresponding to the number "N" and thereby representing the distance between the tracking head and the required position T for the register mark at the start of the next cycle.

If "N" is greater than the counted pulses, the output from the comparator produces additional forward rotation of the nip rolls 11 by energising stepping motor 15 to wind on the web 10 until the comparator output is zero. Similarly, if "N" is less than the number of counted pulses, the stepping motor 15 is reversed to wind back the web 10.

Movement of the web 10 relative to the cutter rolls 12 is possible during this part of the cycle because the raised cutter profile 27 is not in contact with the photographic paper. As shown in Fig. 1, the cutter profile extends from the leading edge 28 to a trailing edge 29 , the remaining sector 30 between the trailing edge 29 and the leading edge 28 being in the range of 10° to 20°.

The machine can also be programmed so that if the tracking head 13 has not detected a mark by the time the cutter roller has completed 360°, a signal is fed from the microprocessor 14 to the stepping motor 15 to drive tected. In this case stepping motor 15 is then energised by "N" pulses to position the mark at position "T" for the start of the next cycle. This program is particularly useful at start-up where the first 30 centimetres or so of a roll of prints is blank. The alternative programmes can be selected manually by means of push buttons on a control panel associated with the microprocessor 14.

If the register marks 19 were regularly spaced along the web 10, it would not be necessary to wind on or wind back the web at the end of each revolution. However, the above described system allows for some variation in the spacing between the register marks due, for example, to overshoot when printing the photographic images along the web 10, and ensures that the cutter profile 27 will always register precisely with the periphery of the printed image being cut out.

CLAIMS

1. A method of synchronising a rotary die cutter with a sequence of printed images being individually cut from a strip, the images being disposed one behind the other along the strip, the method comprising: periodically advancing a predetermined length of the strip into engagement with the cutter, rotating the cutter in synchronism with the periodic advancement of the strip, and releasing the engagement between the cutter and the strip at the end of each cycle to permit adjustment of the registration between the cutter die and the printed images.

2. A method of synchronising a rotary die cutter with a sequence of printed images being individually cut from a strip, the images beingdisposed one behind the other along the strip and each image or predetermined sequence of images having an associated register mark, the method comprising: periodically advancing a predetermined length of the strip to the cutter, rotating the cutter in synchronism with the periodic advancement of the strip sensing a register mark on the strip during each period of advancement, comparing the actual position of the sensed mark at the end of the said period with a predetermined reference position, and adjusting the relative positions of the cutter die and the strip before advancing the next succeeding length of the strip if the comparison indicates that the sensed mark is not at the reference position.

3. A method according to claim 2 in which the comparison is achieved by storing a reference value representing the distance between the sensing head and the reference position, and comparing this stored value with a measured value representing the distance travelled by the second register mark from the time it passes the sensing head until the end of the said period.

4. A method according to claim 3 in which

trolled by cyclic operation of a stepper motor, and in which the measured value is determined in each cycle by counting the pulses fed to the motor after the register mark has been detected, the stored value corresponding to the number of pulses which would be required to bring the register mark to the reference position.

5. A method according to claim 4 in which the adjusting of the relative positions between the cutter and the strip in response to a discrepancy between the stored value and the measured value at the end of each cycle is achieved by driving the stepper motor in a forward or reverse direction to wind-on or wind-back the strip through the appropriate distance until the error is reduced to zero.

6. A method according to claim 5 in which the cutter die extends around only a part of the periphery of the cutter such that at the end of each cycle the die is disengaged from the strip to permit the wind-on or windback of the strip.

7. A method according to any one of the claims 4 to 6 in which the rotary cutter is driven in synchronism with the periodic advancement of the strip by a second stepper motor synchronised with the first stepper motor.

8. Apparatus for cutting out discrete printed images from a sequence of the images disposed one behind the other along a strip, the apparatus comprising: a rotary die cutter, means for cyclically rotating the cutter, and means synchronised with the rotation of the cutter for periodically advancing a predetermined length of the strip into engagement with the cutter, the cutter die extending around only a predetermined sector of the cutter whereby the strip is released from engagement with the die at the end of each cycle to permit adjustment of the registration between the cutter die and the printed images.

9. Apparatus for cutting out discrete printed images from a sequence of the images disposed one behind the other along a strip, each image or sequence of images having an associated register mark, the apparatus comprising: a rotary die cutter, means for cyclically rotating the cutter, means synchronised with the rotation of the cutter for periodically advancing a predetermined length of the strip into engagement with the cutter, means for sensing a register mark on the strip during each period of advancement, means responsive to the output of the sensing means for comparing the actual position of the sensed mark at the end of the said period with a predetermined reference position, and means responsive to the output of the comparator for adjusting the relative positions of the cutter die and the strip before advancing the next succeeding length of the strip if the comparison indicates that the sensed mark is not at the reference position.

10. Apparatus according to claim 9 in which the comparator stores a reference value representing the distance between the sensing head and the reference position and compares this stored value with a measured value representing the distance travelled by the sensed register mark from the time it passes the sensing head until the end of the said period.

11. Apparatus according to claim 10 in which the means for rotating the cutter comprises a first stepper motor and the means for advancing the strip comprises a pair of nip rolls driven by a second stepper motor synchronised with the first stepper motor whereby the measured value is determined in each cycle by counting the pulses fed to the second motor after the register mark has been detected.

12. Apparatus according to claim 9, 10, or 11 in which the cutter die extends around only a predetermined sector of the cutter such that the strip is disengaged from the cutter at the end of each cycle.

13. Apparatus according to claim 12 in which the said sector is in the range of 340° to 350°.

14. A rotary die cutter for cutting out discrete printed images from a sequence of the images disposed one behind the other along a strip, the cutter comprising a pair of rolls for receiving the strip, a first of the rolls having a cutter die disposed about its circumference and the second roll comprising a backing roll against which the strip is urged by the cutter die, the die extending only part way around the circumference of the first roll such that the strip is released from engagement with the die at the end of each revolution of the die.

15. A rotary die cutter according to claim 14 in which the die extends around a predetermined sector of the first roll, the sector being in the range of 340° to 350°.

16. A method of synchronising a rotary die cutter with a sequence of printed images being individually cut from a strip, the method being substantially as herein described with reference to the accompanying drawings.

17. A rotary die cutting machine substantially as herein described with reference to the accompanying drawings.

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